



West River Watershed Summary

West River and Edgewood Park Pond

WATERSHED DESCRIPTION AND MAPS

The West River watershed covers an area of approximately 11,690 acres in the southern coastal area of Connecticut (Figure 1). There are multiple municipalities located at least partially in the watershed, including New Haven, West Haven, Bethany, Hamden, Prospect, and Woodbridge, CT.

The West River watershed includes two segments impaired for recreation due to elevated bacteria levels. These segments were assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2010 303(d) list of impaired waterbodies. One segment in the watershed is currently unassessed as of the writing of this document. This does not suggest that there are no issues on these segments, but indicates a lack of current data to evaluate the segments as part of the assessment process. An excerpt of the Integrated Water Quality Report is included in Table 1 to show the status of waterbodies in the watershed (CTDEEP, 2010).

The West River (CT5305-00_01) begins at the outlet of Konolds Pond in Woodbridge and flows 3.23 miles south into New Haven (Figure 2). Edgewood Park Pond (CT5305-00-3-L1_01) is located in downtown New Haven within Edgewood Park east of the Yale University athletic fields (Figure 4).

The West River and Edgewood Park Pond have a water quality classification of A. Designated uses include a potential drinking water supply, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. Both segments are impaired due to elevated bacteria concentrations, affecting the designated use of recreation. As there are no designated beaches on these segments, the specific recreation impairment is for non-designated swimming and other water contact related activities.

Impaired Segment Facts

Impaired Segments Name:

1. West River (CT5305-00_01)
2. Edgewood Park Pond (CT5305-00-3-L1_01)

Municipalities: New Haven, Woodbridge

Impaired Segment Length /

Area: CT5305-00_01 (3.23 miles), CT5305-00-3-L1_01 (2.72 acres)

Water Quality Classifications:

Class A

Designated Use Impairments:

Recreation

Sub-regional Basin Name and

Code: West River, 5305

Regional Basin: South Central

Western Complex

Major Basin: South Central Coast

Watershed Area (acres): 11,690

MS4 Applicable? Yes

Applicable Season: Recreation

Season (May 1 to September 30)

Figure 1: Watershed location in Connecticut

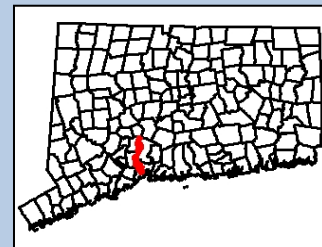
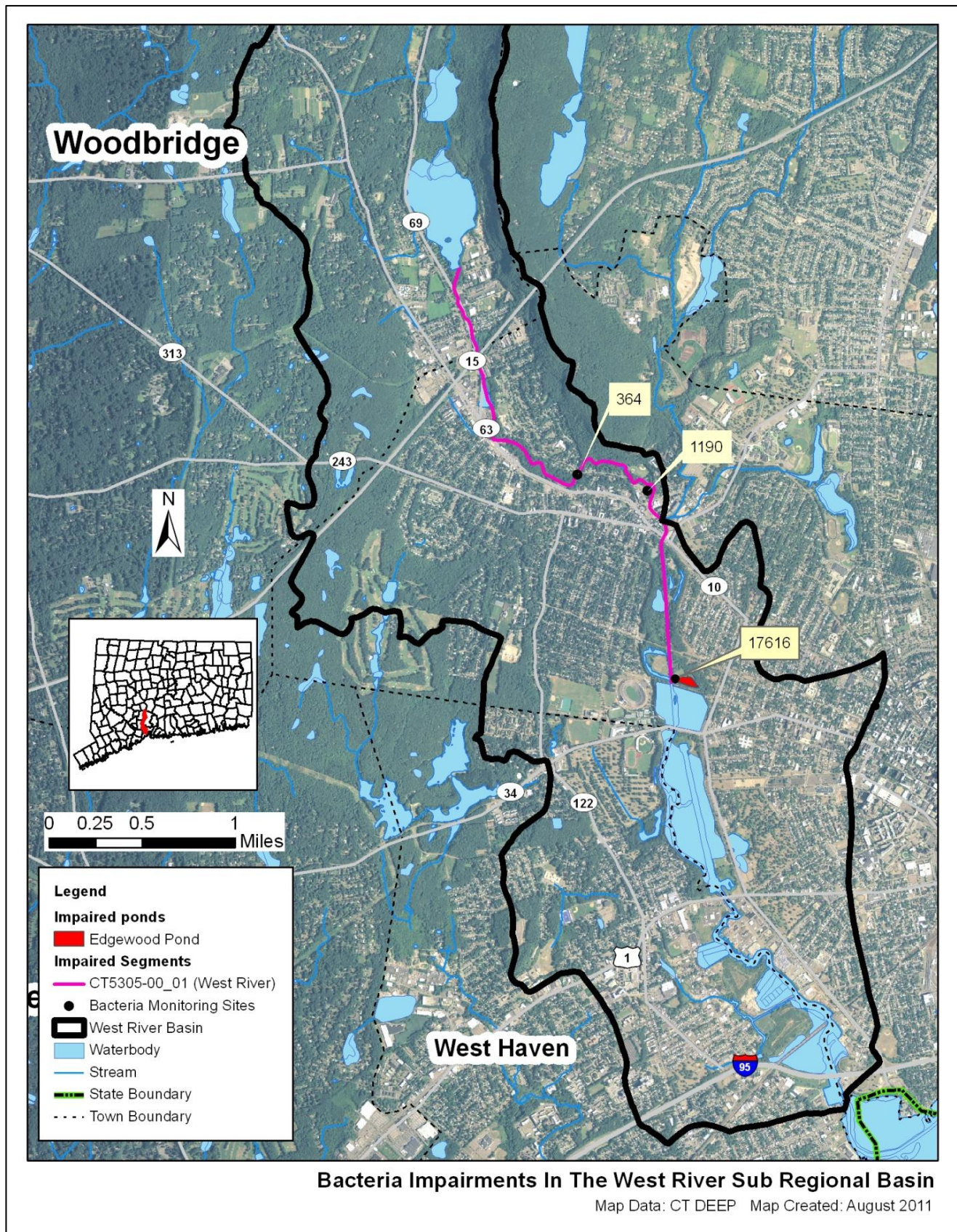


Table 1: Impaired segments and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles/ Acres	Aquatic Life	Recreation	Fish Consumption
CT5305-00-3-L1_01	Edgewood Park Pond (New Haven)	Along eastern bank of West River, just US of Chapel St, New Haven.	2.72	FULL	NOT	FULL
CT5305-00_01	West River (New Haven/Woodbridge)-01	From head of tide (tide gates) at Chapel Street crossing (just DS of Edgewood Park Pond), New Haven, US to Konolds Pond outlet dam (just US of Bradley Road crossing), Woodbridge.	3.23	NOT	NOT	FULL
CT5305-00_02	West River (Woodbridge/Bethany)- 02	From inlet to Konolds Pond (northern portion of lake, east side of Route 69), Woodbridge, US to Lake Bethany outlet dam, Bethany. Segment includes Lake Dawson and Lake Watrous.	4.9	U	U	FULL
Shaded cells indicate impaired segment addressed in this TMDL FULL = Designated Use Fully Supported NOT = Designated Use Not Supported U = Unassessed						

Figure 2: GIS map featuring general information of the West River watershed at the sub-regional level



Land Use

Existing land use can affect the water quality of waterbodies within a watershed (USEPA, 2011c). Natural processes, such as soil infiltration of stormwater and plant uptake of water and nutrients, can occur in undeveloped portions of the watershed. As impervious surfaces (such as rooftops, roads, and sidewalks) increase within the watershed landscape from commercial, residential, and industrial development, the amount of stormwater runoff to waterbodies also increases. These waterbodies are negatively affected as increased pollutants from nutrients and bacteria from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities become entrained in this runoff. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011c).

As shown in Figures 3 and 4, the West River watershed consists of 50% forest, 41% urban area, 2% agriculture, and 7% water. Portions of the watershed in New Haven, particularly surrounding the West River and Edgewood Park Pond, are characterized by urban land use. There is one small agricultural area adjacent to the West River near the beginning of the impaired segment. While much of the northern portion of the watershed upstream of the West River's impaired segment is dominated by forest, nearly all land surrounding both impaired segments is dominated by urban land use, including Yale University in New Haven. This urban development consists of dense residential development.

Figure 3: Land use within the West River watershed

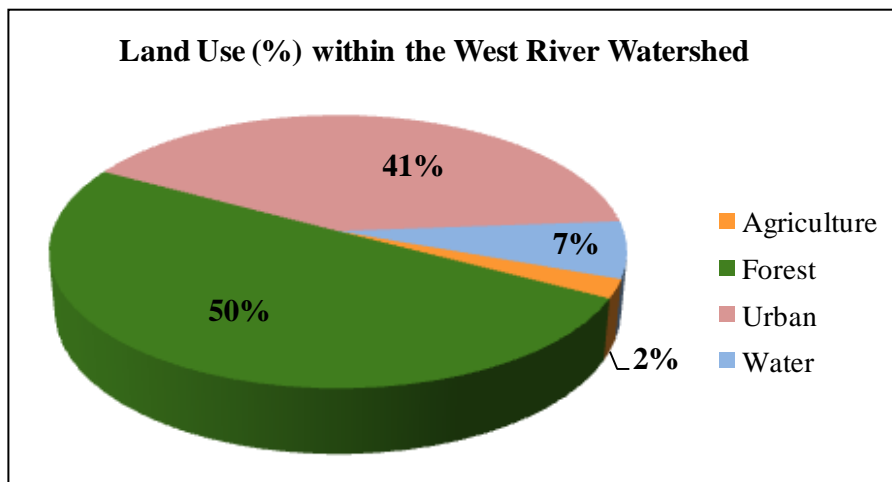
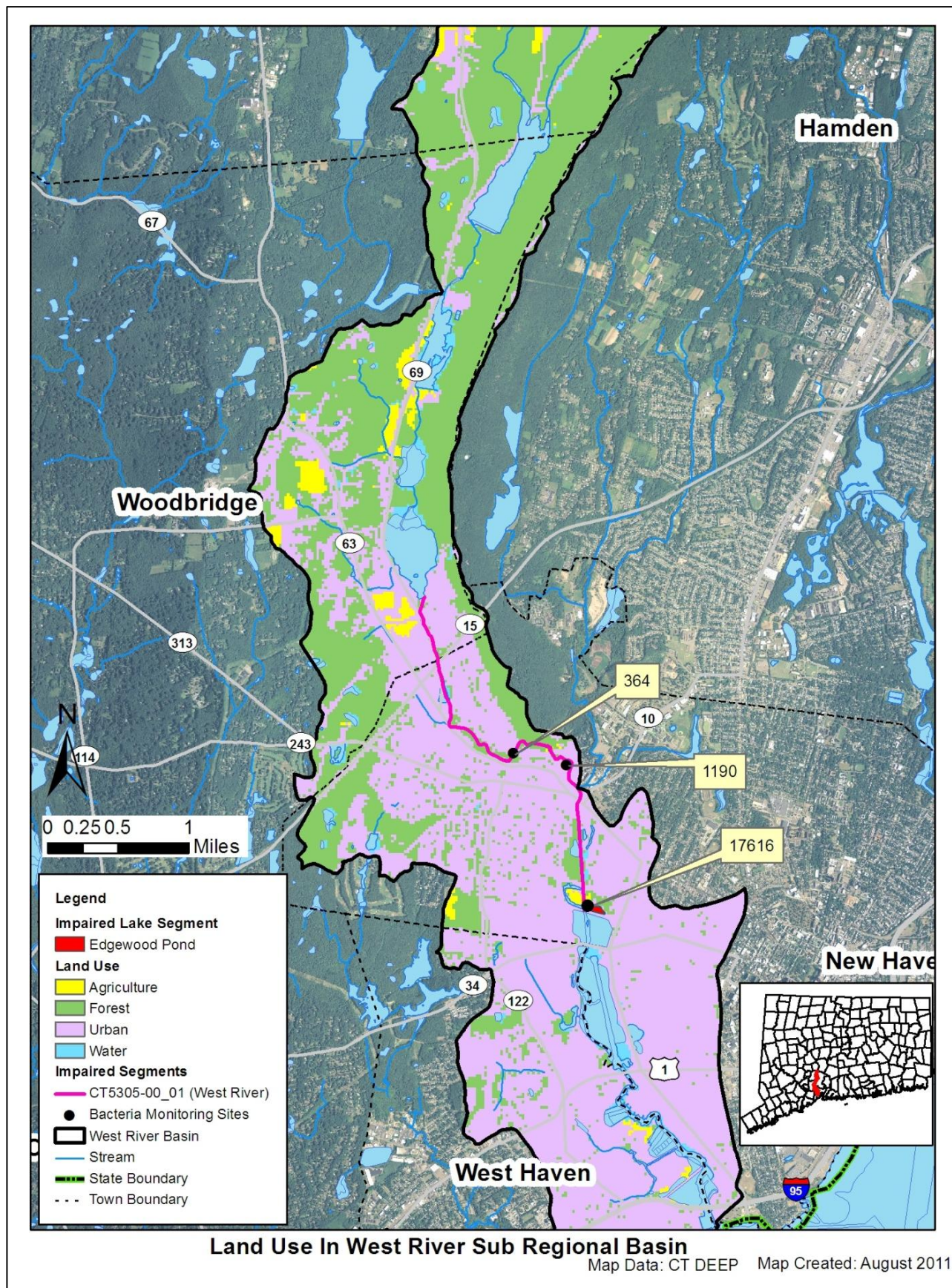


Figure 4: GIS map featuring land use for the West River watershed at the sub-regional level



WHY IS A TMDL NEEDED?

E. coli is the indicator bacteria used for comparison with the CT State criteria in the CT Water Quality Standards (WQS) (CTDEEP, 2011). All data results are from CT DEEP, USGS, Bureau of Aquaculture, or volunteer monitoring efforts at stations located on the impaired segments.

Table 2: Sampling station location description for the impaired segments in the West River watershed (stations organized downstream to upstream)

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT5305-00-3-L1_01	Edgewood Park Pond	17616	Pond outfall	New Haven	41.314134	-72.956365
CT5305-00_01	West River	1190	500 meters US Blake St	New Haven	41.329000	-72.959000
CT5305-00_01	West River	364	Valley Road	New Haven	41.330264	-72.966261

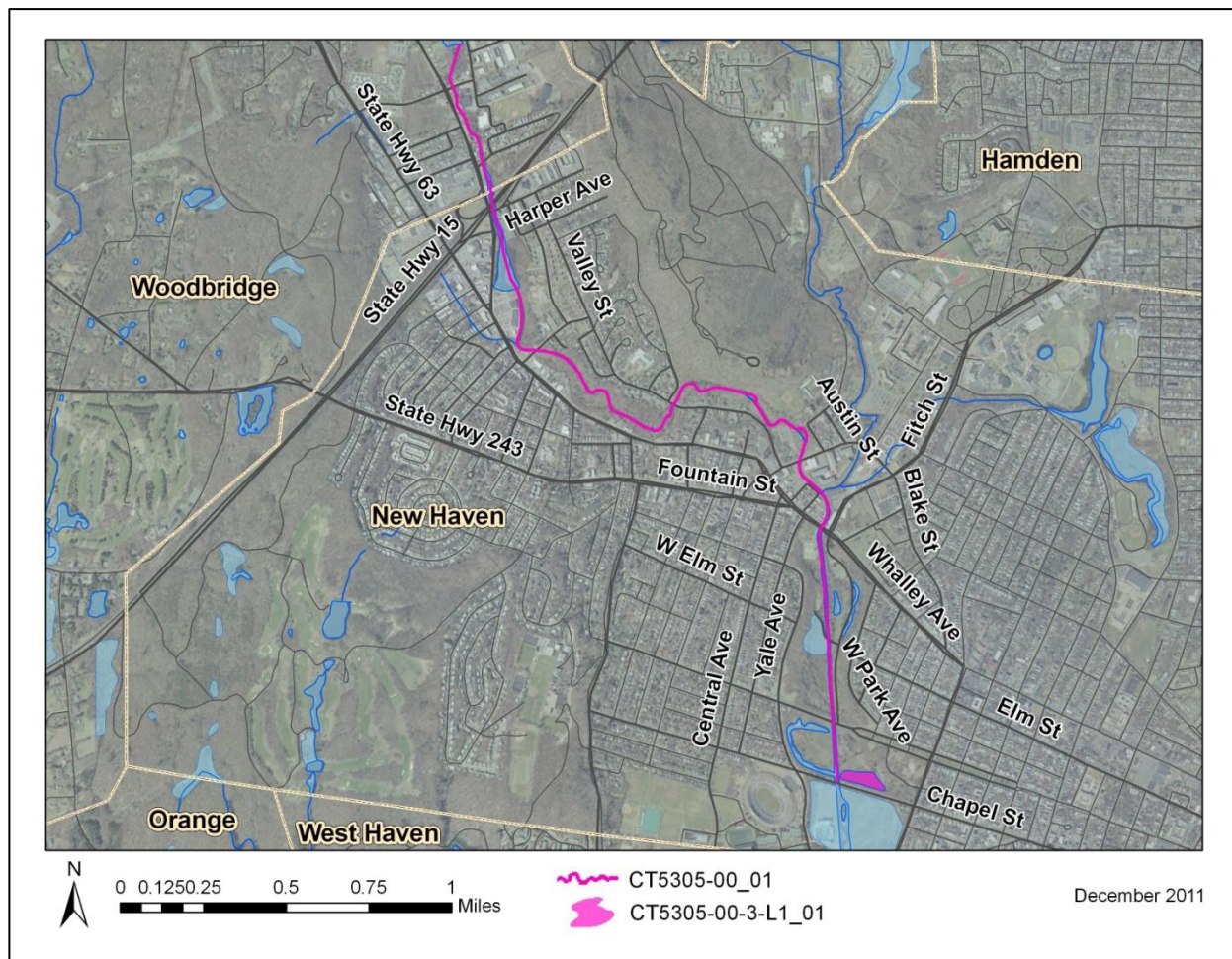
The impaired segment of the West River (CT5305-00_01) is a Class A freshwater river (Figure 5). Edgewood Park Pond (CT5305-00-3-L1_01) is a Class A freshwater pond. Their applicable designated uses are potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supplies. Water quality analyses were conducted using data from two sampling locations (Stations 1190 and 364) on the impaired segment of the West River, and at one sampling location (Station 17616) on Edgewood Park Pond (Table 2).

The water quality criteria for *E. coli*, along with bacteria sampling results in 1998, 2010, and 2011, are presented in Tables 10 and 11 for the impaired segments. The annual geometric mean for Stations 1190 and 364 on the West River exceeded the WQS for *E. coli* in 1998 and 2010. Single sample values at these stations also exceeded the WQS for *E. coli* multiple times each sampling year. For Edgewood Park Pond, single sample values for Station 17616 exceeded the WQS for *E. coli* on multiple sampling dates. The annual geometric mean for Station 17616 exceeded the WQS for *E. coli* in 2011.

To aid in identifying possible bacteria sources, the geometric mean was also calculated for each station for wet-weather and dry-weather sampling days, where appropriate (Tables 10 and 11). For the impaired segment of the West River, the geometric mean during wet and dry-weather exceeded the WQS for *E. coli* at Station 1190. There were insufficient data to calculate wet-weather geometric means for Station 364. For Edgewood Park Pond, the geometric mean during wet and dry-weather exceeded the WQS for *E. coli* at Station 17616. The geometric mean during wet-weather was 18 times greater than dry-weather on Edgewood Park Pond at Station 17616.

Due to the elevated bacteria measurements presented in Tables 10 and 11, the West River and Edgewood Park Pond did not meet CT's bacteria WQS, were identified as impaired, and were placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with State WQS.

Figure 5: Aerial map of the West River and Edgewood Park Pond



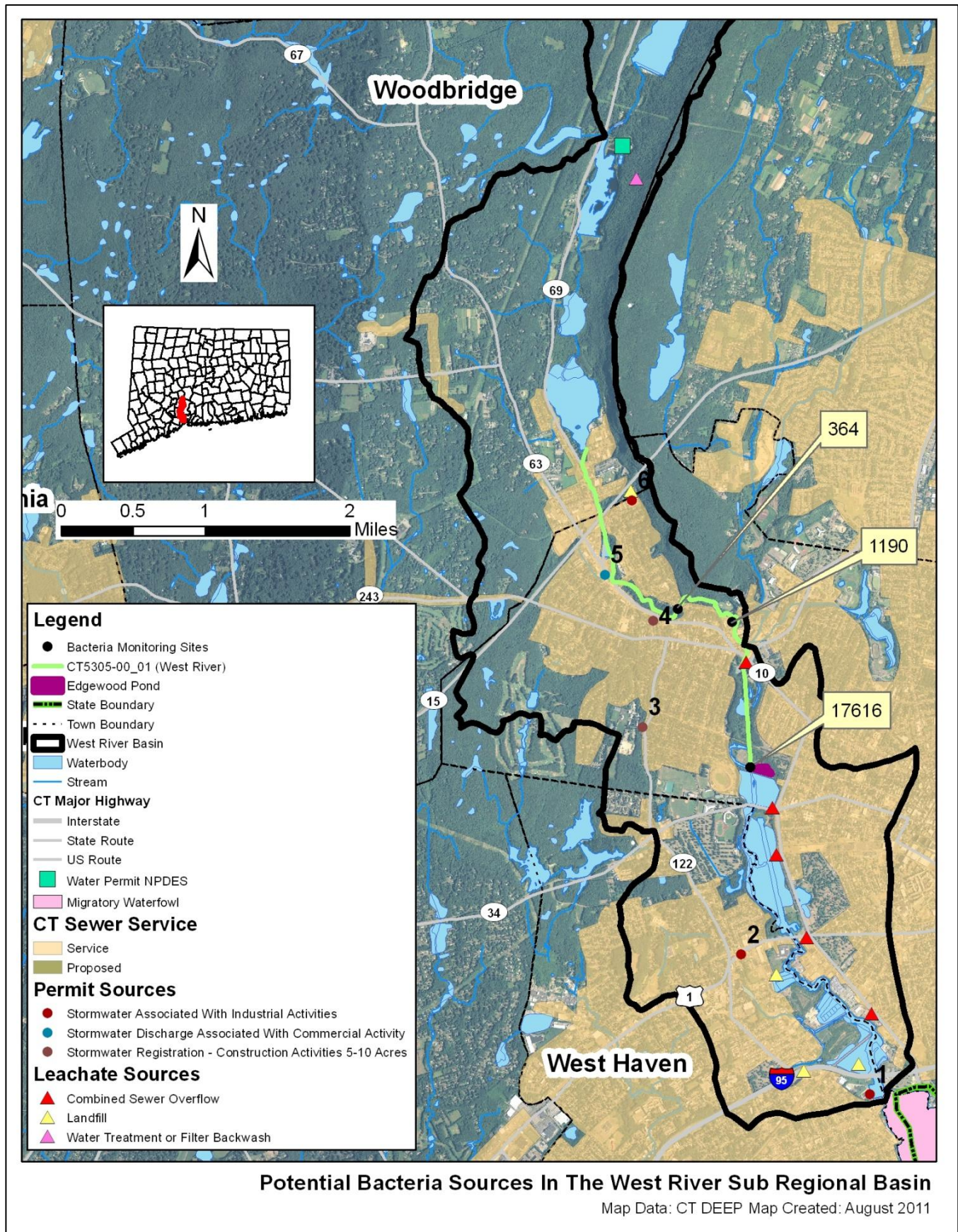
POTENTIAL BACTERIA SOURCES

Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbody is presented in Table 3 and Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study segments. Further monitoring and investigation will confirm listed sources and discover additional ones. Some segments in this watershed are currently listed as unassessed by CT DEEP procedures. This does not suggest that there are no potential issues on this segment, but indicates a lack of current data to evaluate the segment as part of the assessment process. For some segments, there are data from permitted sources, and CT DEEP recommends that any elevated concentrations found from those permitted sources be addressed through voluntary reduction measures. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement these TMDLs.

Table 3: Potential bacteria sources in the West River watershed

Impaired Segment	Permit Source	Illicit Discharge	CSO/SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/ Pets	Other
West River CT5305-00_01	x	x	x	x	x	x	x	x
Edgewood Park Pond CT5305-00	x	x				x	x	x

Figure 6: Potential bacteria sources in the West River watershed



The potential sources map for the impaired basin was developed after thorough analysis of available data sets. If information is not displayed in the map, then no sources were discovered during the analysis. The following is the list of potential sources that were evaluated: problems with migratory waterfowl, golf course locations, reservoirs, proposed and existing sewer service, cattle farms, poultry farms, permitted sources of bacteria loading (surface water discharge, MS4 permit, industrial stormwater, commercial stormwater, groundwater permits, and construction related stormwater), and leachate and discharge sources (agricultural waste, CSOs, failing septic systems, landfills, large septic tank leach fields, septage lagoons, sewage treatment plants, and water treatment or filter backwash).

Point Sources

Permitted sources within the watershed that could potentially contribute to bacteria loading are identified in Table 4. This table includes permit types that may or may not be present in the impaired watershed. A list of active permits in the watershed is included in Table 5. Additional investigation and monitoring may reveal the presence of additional discharges in the watershed. Available effluent data from each of these permitted categories found within the watershed are compared to the CT State WQS for the appropriate receiving waterbody use and type. When available, bacteria data results from these permitted sources are listed in Tables 6 and 7.

Table 4: General categories list of other permitted discharges

Permit Code	Permit Description Type	Number in watershed
CT	Surface Water Discharges	0
GPL	Discharge of Swimming Pool Wastewater	0
GSC	Stormwater Discharge Associated with Commercial Activity	1
GSI	Stormwater Associated with Industrial Activity	3
GSM	Part B Municipal Stormwater MS4	1
GSN	Stormwater Registration – Construction	2
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	0

Permitted Sources

As shown in Table 5, there are multiple permitted discharges in the West River watershed. Bacteria data from 2001-2003 from several of these industrial permitted facilities are included in Table 6. Though this data cannot be compared to a water quality standard as there is no recreation standard for fecal coliform bacteria, multiple samples were high. The US Postal Service (GSI001066) in New Haven exceeded 20,000 colonies/100mL, the West Cover Marina (GSI001013) in West Haven exceeded 10,000 colonies/100mL, and H. Bixon & Sons (GSI000228) and Cover-It Inc. (GSI001177) in West Haven exceeded 1,000 colonies/100mL on several sample dates. The discharges in West Haven are downstream of the impaired segment of the West River and Edgewood Park Pond. While not impacting the impaired segment directly, the sample results show that permitted sources near the impaired segments may be a potential source of bacterial contamination (Figure 6).

Since the MS4 permits are not targeted to a specific location, but the geographic area of the regulated municipality, there is no one accurate location on the map to display the location of these permits. One dot will be displayed at the geographic center of the municipality as a reference point. Sometimes this location falls outside of the targeted watershed and therefore the MS4 permit will not be displayed in the Potential Sources Map. Using the municipal border as a guideline will show which areas of an affected watershed are covered by an MS4 permit.

Table 5: Permitted facilities within the West River watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
New Haven	City of New Haven	GSM000030	Part B Municipal Stormwater MS4	New Haven, City of	N/A
New Haven	State Of Connecticut Department Of Transportation	GSI000042	Stormwater Associated With Industrial Activities	New Haven Maintenance Facility	6
New Haven	Acl Smartyale, Llc	GSC000125	Stormwater Discharge Associated With Commercial Activity	Walley Commons	5
New Haven	State Of Connecticut Department Of Transportation	GSN001838	Stormwater Registration - Construction Activities 5-10 Acres	New Haven Rail Yard Fueling Facility Improvements	4
New Haven	H.I. Stone & Son Inc.	GSN002108	Stormwater Registration - Construction Activities 5-10 Acres	Hopkins School Inc.	3
West Haven	West Cove Marina Corporation	GSI001013	Stormwater Associated With Industrial Activities	West Cove Marina	1
West Haven	Connecticut Air National Guard	GSI001590	Stormwater Associated With Industrial Activities	Air Control Squadron	2

Table 6: Industrial permits in the West River watershed and available fecal coliform data (colonies/100mL). The results cannot be compared to the water quality standard as there is no recreation standard for fecal coliform.

Town	Location	Permit Number	Receiving Water	Sample Location	Sample Date	Result
New Haven	New Haven Mfg Co. LLC	GSI1033	West River	Drainage Structure	07/11/01	900
New Haven	US Postal Service	GSI1066	West River	SW-1	08/10/01	100
New Haven	US Postal Service	GSI1066	West River	SW-1	08/29/02	20,000
New Haven	H. Bixon & Sons	GSI228	West River	003	07/26/01	6,400
West Haven	West Cove Marina	GSI1013	West River	N end of yard	09/14/03	10,000

Table 6: Industrial permits in the West River watershed and available fecal coliform data (colonies/100mL). The results cannot be compared to the water quality standard as there is no recreation standard for fecal coliform. (continued)

Town	Location	Permit Number	Receiving Water	Sample Location	Sample Date	Result
West Haven	Cover-It Inc.	GSI1177	West River	OF 001	10/11/02	2,000
West Haven	Cover-It Inc.	GSI1177	West River	OF 001	10/16/02	620
West Haven	Cover-It Inc.	GSI1177	West River	OF 004	10/11/02	2,000
West Haven	Cover-It Inc.	GSI1177	West River	OF 004	10/16/02	1,290
Woodbridge	Plastic Forming	GSI825	West River	001	07/11/01	100
Woodbridge	Plastic Forming	GSI825	West River	001	07/11/02	<100
Woodbridge	Plastic Forming	GSI825	West River	001	07/09/03	100

Municipal Stormwater Permitted Sources

Per the EPA Phase II Stormwater rule all municipal storm sewer systems (MS4s) operators located within US Census Bureau Urbanized Areas (UAs) must be covered under MS4 permits regulated by the appropriate State agency. There is an EPA waiver process that municipalities can apply for to not participate in the MS4 program. In Connecticut, EPA has granted such waivers to 19 municipalities. All participating municipalities within UAs in Connecticut are currently regulated under MS4 permits by CT DEEP staff in the MS4 program.

The US Census Bureau defines a UA as a densely settled area that has a census population of at least 50,000. A UA generally consists of a geographic core of block groups or blocks that exceeds the 50,000 people threshold and has a population density of at least 1,000 people per square mile. The UA will also include adjacent block groups and blocks with at least 500 people per square mile. A UA consists of all or part of one or more incorporated places and/or census designated places, and may include additional territory outside of any place. (67 FR 11663)

For the 2000 Census a new geographic entity was created to supplement the UA blocks of land. This created a block known as an Urban Cluster (UC) and is slightly different than the UA. The definition of a UC is a densely settled area that has a census population of 2,500 to 49,999. A UC generally consists of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile. A UC consists of all or part of one or more incorporated places and/or census designated places; such a place(s) together with adjacent territory; or territory outside of any place. The major difference is the total population cap of 49,999 people for a UC compared to >50,000 people for a UA. (67 FR 11663)

While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some municipalities that appear to be within an MS4 program that are not currently regulated through an MS4 permit. This oversight can explain a municipality that is at least partially shaded grey in the maps

and there are no active MS4 reporting materials or information included in the appropriate appendix. While these areas are not technically in the MS4 permit program, they are still considered urban by the cluster definition above and are likely to contribute similar stormwater discharges to affected waterbodies covered in this TMDL.

As previously noted, EPA can grant a waiver to a municipality to preclude their inclusion in the MS4 permit program. One reason a waiver could be granted is a municipality with a total population less than 1000 people, even if the municipality was located in a UA. There are 19 municipalities in Connecticut that have received waivers, this list is: Andover, Bozrah, Canterbury, Coventry, East Hampton, Franklin, Haddam, Killingworth, Litchfield, Lyme, New Hartford, Plainfield, Preston, Salem, Sherman, Sprague, Stafford, Washington, and Woodstock. There will be no MS4 reporting documents from these towns even if they are displayed in an MS4 area in the maps of this document.

The list of US Census UCs is defined by geographic regions and is named for those regions, not necessarily by following municipal borders. In Connecticut the list of UCs includes blocks in the following Census Bureau regions: Colchester, Danielson, Lake Pocotopaug, Plainfield, Stafford, Storrs, Torrington, Willimantic, Winsted, and the border area with Westerly, RI (67 FR 11663). Any MS4 maps showing these municipalities may show grey areas that are not currently regulated by the CT DEEP MS4 permit program.

The impaired segments of the West River watershed are located within the City of New Haven and the Town of Woodbridge. Both municipalities have designated urban areas, as defined by the U.S. Census Bureau, and are required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the Connecticut Department of Energy and Environmental Protection (DEEP) (Figure 7). This general permit is only applicable to municipalities that are identified in Appendix A of the MS4 permit that contain designated urban areas and discharge stormwater via a separate storm sewer system to surface waters of the State. The permit required municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants as well as to protect water quality. The MS4 permit is discussed further in the “TMDL Implementation Guidance” section of the core TMDL document. Additional information regarding stormwater management and the MS4 permit can be obtained on CTDEEP’s website (http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654).

Multiple MS4 outfalls have been sampled for *E. coli* bacteria in the watershed (Table 7). The City of New Haven sampled two outfalls in 2005, 2006, 2007, and 2010. Both sampled outfall in New Haven exceeded the single sample WQS of 410 colonies/100mL for *E. coli*. The Town of Woodbridge sampled four outfalls with approximately half of these samples exceeding the single sample WQS for *E. coli*.

Figure 7: MS4 areas of the West River watershed

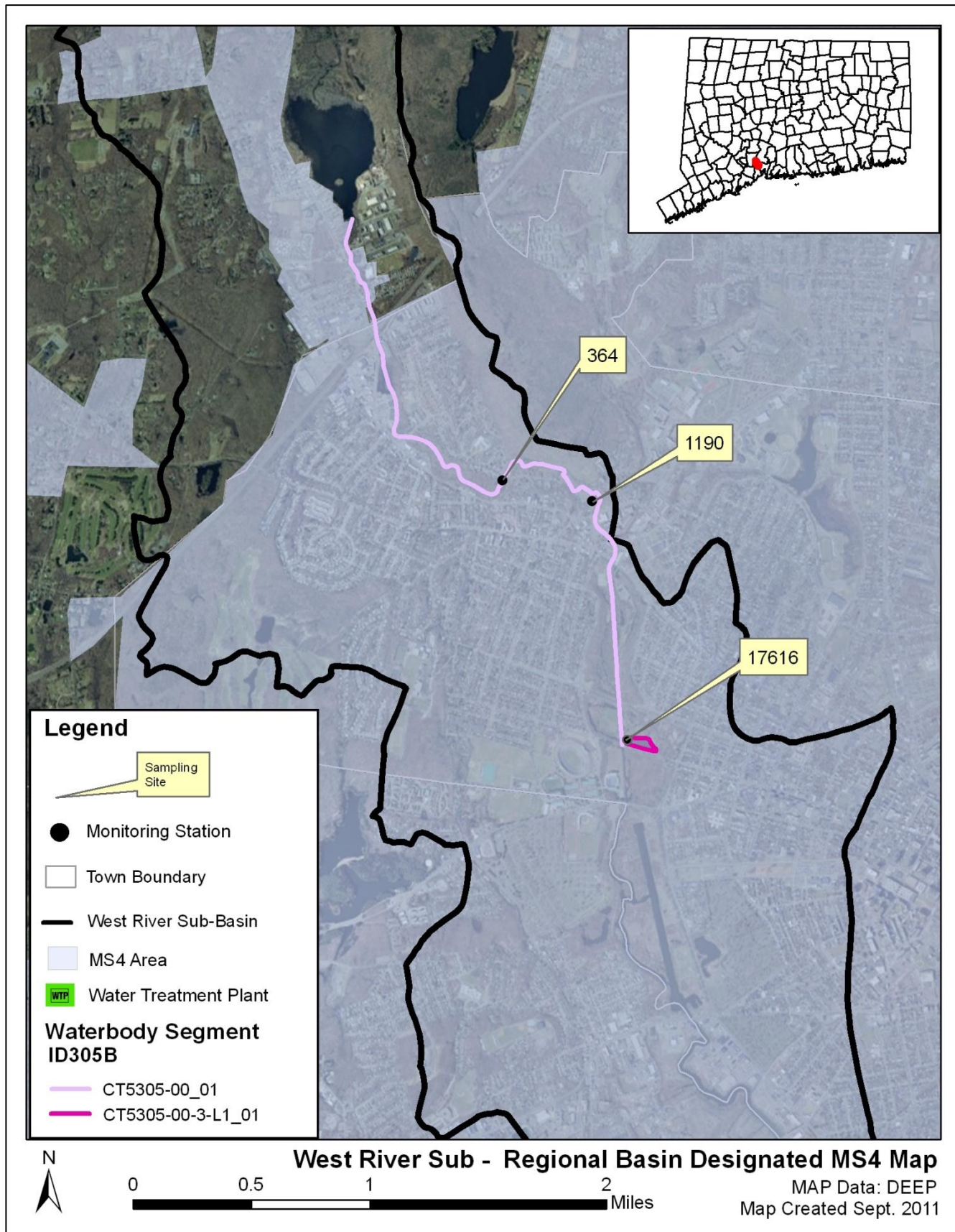


Table 7: MS4 *E. coli* (colonies/100 mL) outfall samples in the West River watershed

Town	Location	MS4 Type	Receiving Waters	Sample Date	Result
New Haven	E543,105 N175,173 #70 chapel street bridge	Residential	West River	06/28/05	20,100
New Haven	E543,105 N175,173 #70 chapel street bridge	Residential	West River	11/09/05	850
New Haven	E543,105 N175,173 #70 chapel street bridge	Residential	West River	09/27/10	6,400
New Haven	MS#6 outlet 70 Chapel St Bridge over West River	Residential	West River	09/11/07	>2000
New Haven	MS#7 outlet 70 Chapel St Bridge over West River	Residential	West River	10/17/06	>4000
Woodbridge	Bradley Rd N of Lunar Dr W side of road SW-E	Commercial	West River	11/12/04	5,200
Woodbridge	Bradley Rd N of Lunar Dr W side of road SW-E	Commercial	West River	11/09/05	>2419.6
Woodbridge	Bradley Rd N of Lunar Dr W side of road SW-E	Commercial	West River	11/08/06	122
Woodbridge	Bradley Rd N of Lunar Dr W side of road SW-E	Commercial	West River	01/11/08	99
Woodbridge	Bradley Rd N of Lunar Dr W side of road SW-E	Commercial	West River	11/06/08	1,414
Woodbridge	Bradley Rd N of Lunar Dr W side of road SW-E	Commercial	West River	09/11/09	>2419.6
Woodbridge	Bradley Rd N of Lunar Dr W side of road SW-E	Commercial	West River	10/15/10	345
Woodbridge	Bradley Rd outfall @ wingwall of Bradley Rd bridge-SW corner SW-C	Industrial	West River	11/12/04	400
Woodbridge	Bradley Rd outfall @ wingwall of Bradley Rd bridge-SW corner SW-C	Industrial	West River	11/09/05	38
Woodbridge	Bradley Rd outfall @ wingwall of Bradley Rd bridge-SW corner SW-C	Industrial	West River	11/08/06	435
Woodbridge	Bradley Rd outfall @ wingwall of Bradley Rd bridge-SW corner SW-C	Industrial	West River	01/11/08	488
Woodbridge	Bradley Rd outfall @ wingwall of Bradley Rd bridge-SW corner SW-C	Industrial	West River	11/06/08	41
Woodbridge	Bradley Rd outfall @ wingwall of Bradley Rd bridge-SW corner SW-C	Industrial	West River	09/11/09	1,733
Woodbridge	Bradley Rd outfall @ wingwall of Bradley Rd bridge-SW corner SW-C	Industrial	West River	10/15/10	488

Table 7: MS4 *E. coli* (colonies/100 mL) outfall samples in the West River watershed (continued)

Town	Location	MS4 Type	Receiving Waters	Sample Date	Result
Woodbridge	Merrit Ave @ bridge SW corner SW-F	Industrial	West River	11/12/04	1,700
Woodbridge	Merrit Ave @ bridge SW corner SW-F	Industrial	West River	11/09/05	3
Woodbridge	Merrit Ave @ bridge SW corner SW-F	Industrial	West River	11/08/06	345
Woodbridge	Merrit Ave @ bridge SW corner SW-F	Industrial	West River	01/11/08	461
Woodbridge	Merrit Ave @ bridge SW corner SW-F	Industrial	West River	09/11/09	141
Woodbridge	Merrit Ave @ bridge SW corner SW-F	Industrial	West River	10/15/10	345
Woodbridge	S Bradley Rd @ sharp bend SW side of road SW-D	Commercial	West River	11/12/04	500
Woodbridge	S Bradley Rd @ sharp bend SW side of road SW-D	Commercial	West River	11/09/05	31
Woodbridge	S Bradley Rd @ sharp bend SW side of road SW-D	Commercial	West River	11/08/06	38
Woodbridge	S Bradley Rd @ sharp bend SW side of road SW-D	Commercial	West River	01/11/08	10
Woodbridge	S Bradley Rd @ sharp bend SW side of road SW-D	Commercial	West River	11/06/08	770
Woodbridge	S Bradley Rd @ sharp bend SW side of road SW-D	Commercial	West River	11/06/08	1,046
Woodbridge	S Bradley Rd @ sharp bend SW side of road SW-D	Commercial	West River	09/11/09	1,300
Woodbridge	S Bradley Rd @ sharp bend SW side of road SW-D	commercial	West River	10/15/10	205
Shaded cells indicate an exceedance of single-sample based water quality criteria (410 colonies/100 mL)					

Non-point Sources

Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture, and contact recreation (swimming or wading). Potential sources of NPS within the West River watershed are described below.

Combined Sewer Overflows (CSOs)

Combined sewer overflows (CSOs) represent a likely source of bacterial contamination within the West River watershed, specifically to the impaired segment of the West River. Combined sewers systems carry water from both sanitary and storm sewers. These systems convey their contents to a publicly owned treatment works (POTW). When there is a significant rain event, the storm sewers collect large volumes of water that get transferred to the combined sewer. When the volume of water entering the POTW surpasses the capacity of the facility, the combined sewers will overflow at designated CSOs to reduce the

volume of water entering the facility. When combined sewers overflow, they deposit raw sewage with high levels of bacteria into the receiving water.

As shown in Figure 6, there is a CSO located on the impaired segment near the intersection of Route 63 and Route 10 in New Haven at the north end of Edgewood Park. There are also several CSOs located downstream of the impaired segment of the West River and Edgewood Park Pond, and therefore are not impacting the impaired segments discussed in this TMDL. However, these CSOs may be contributing bacteria to the lower reaches of the West River. The CSO located on the West River near the north end of Edgewood Park is a likely source of bacterial contamination to the impaired segment of the West River.

Stormwater Runoff from Developed Areas

The majority of the West River watershed around the impaired segment and Edgewood Park Pond is developed. Approximately 41% of the land use in the watershed is considered urban, and much of that area is concentrated around the impaired segment in the Town of Woodbridge and the City of New Haven (Figures 4 and 9). Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate into the soil. Studies have shown a link between increasing impervious cover and degrading water quality conditions in a watershed (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin *et al.*, 2000).

Approximately half of the West River watershed is characterized by land with 0 to 6% impervious cover, and the other half is characterized by greater than 16% impervious cover (Figure 8). The entire length of the impaired segment of the West River and Edgewood Park Pond are surrounded by areas with over 16% impervious cover (Figure 9).

High geometric means during wet-weather may indicate that stormwater runoff is contributing to the bacterial impairment in a river segment. As shown in Tables 10 and 11, the geometric mean for wet weather exceeded the WQS at Station 1190 on the impaired segment of the West River and at Station 17616 in Edgewood Park Pond. These areas are developed with high levels of impervious surfaces, indicating that stormwater runoff is a potential source of bacterial contamination.

Figure 8: Range of impervious cover (%) in the West River watershed

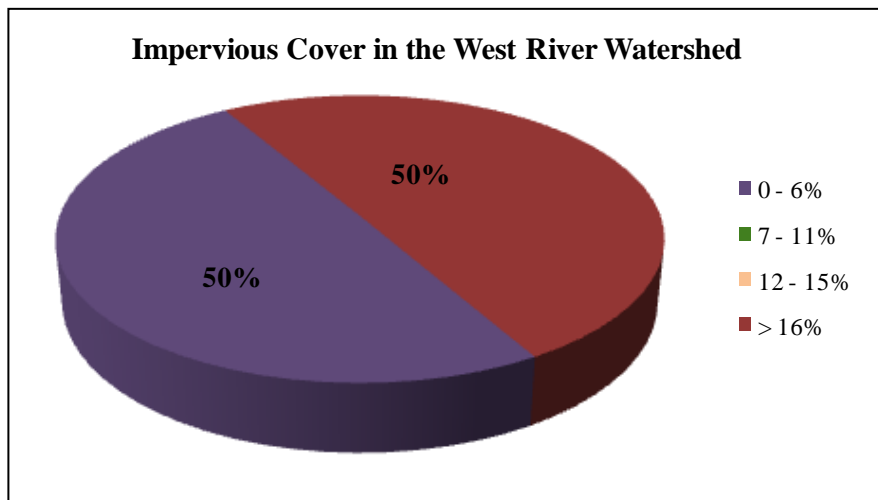
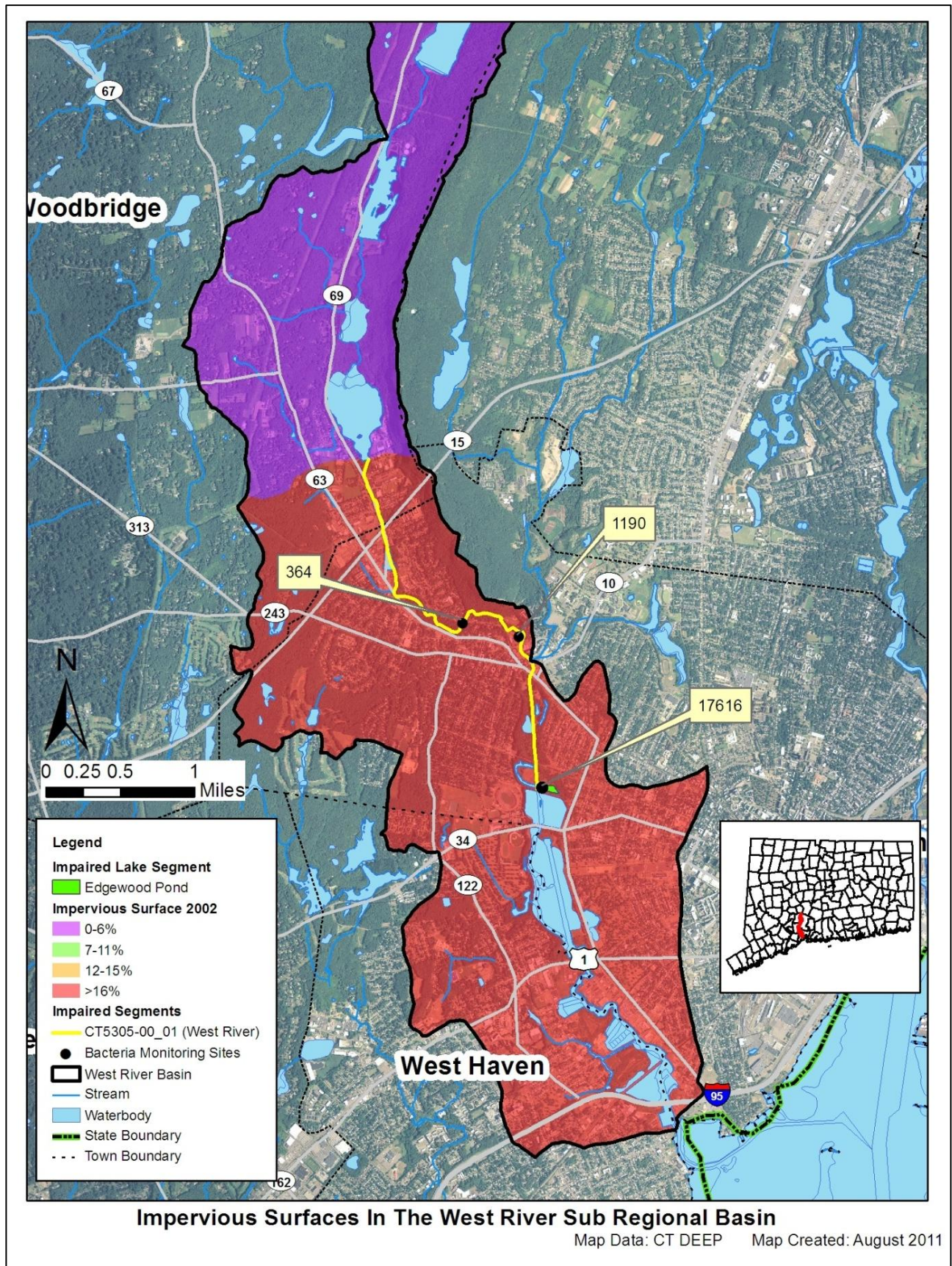


Figure 9: Impervious cover (%) for the West River sub-regional watershed



Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the West River watershed represent a potential source of bacteria. With the construction of roads and drainage systems, these wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface water. These physical land alterations can exacerbate the impact of natural sources on water quality (USEPA, 2001).

Edgewood Park Pond is located within New Haven's Edgewood Park. The open space within the park and the pond itself may provide an area for waterfowl to congregate. There are also several recreational fields (West River Field and West Rock Playground) and small ponds (Lilly Pond) located along the impaired segment of the West River in New Haven. Geese and other waterfowl are known to congregate in open areas including recreational fields, agricultural cropfields, and golf courses. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas and cause water quality problems due to bacterial contamination associated with their droppings. Large populations of geese can also lead to habitat destruction as a result of overgrazing on wetland and riparian plants. These factors make wildlife waste a potential source of bacteria to the West River's impaired segment and Edgewood Park Pond.

Dense residential development surrounds much of the impaired segment of the West River in Woodbridge and New Haven and Edgewood Park Pond in New Haven (Figure 5). When not properly disposed, waste from domestic animals such as dogs can enter surface waters directly or through stormwater infrastructure. Therefore, domestic animal waste may also be contributing to bacteria concentrations in the impaired segment of the West River and Edgewood Park Pond.

Insufficient Septic Systems and Illicit Discharges

As shown in Figure 6, nearly all residents around the impaired segment of the West River and Edgewood Park Pond have access to a sanitary sewer. However, a small portion of the watershed in Woodbridge near the beginning of the impaired segment of the West River rely on onsite wastewater treatment systems, such as septic systems. Insufficient or failing septic systems can be significant sources of bacteria by allowing raw waste to reach surface waters. In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient or failing septic systems in a specific municipality. The Town of Woodbridge does not have its own health director, and is part of the Quinnipiac Valley Health District (www.qvhd.org). The City of New Haven has its own Health Department (www.cityofnewhaven.com/health/index.asp).

Nearly the entire area surrounding the West River's impaired segment and Edgewood Park Pond is serviced by sanitary sewer. Sewer system leaks and other illicit discharges that are located within the watershed of the impaired segment of the West River and Edgewood Park Pond may be contributing bacteria to these waterbodies.

High geometric means during dry-weather may indicate the presence of insufficient septic systems or other illicit discharges. As shown in Tables 10 and 11, the geometric mean for dry weather exceeded the WQS at Station 17616 in Edgewood Park Pond and at Station 364 in the impaired segment of the West River. The area encompassing these stations is serviced by the municipal sanitary sewer system and by septic systems and may be receiving bacteria from leaks in the sewer system, other illicit discharges, or insufficient septic systems.

Agricultural Activities

Agricultural operations are an important economic activity and landscape feature in many areas of the State. Runoff from agricultural fields may contain pollutants such as bacteria and nutrients (USEPA, 2011a). This runoff can include pollutants from farm practices such as storing manure, allowing livestock to wade in nearby waterbodies, applying fertilizer, and reducing the width of vegetated buffer along the shoreline. Agricultural land use makes up only 2% of the West River watershed. There is an agricultural operation near the beginning of the impaired segment of the West River in Woodbridge. This agricultural area is potentially carrying pollutants, including bacteria, into the impaired segment of the West River.

Additional Sources

The Town of Woodbridge and the City of New Haven have multiple MS4 discharges that contain high levels of *E. coli* bacteria (Table 7). Also, the US Postal Service in New Haven has a permitted discharge that has shown high levels of fecal coliform bacteria (Table 6). These sample results indicate that the MS4 discharges from Woodbridge and New Haven, as well as the discharge from the US Postal Service, may also be a source of bacterial contamination.

There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in the West River and Edgewood Park Pond. Further monitoring and investigation will confirm listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.

Land Use/Landscape

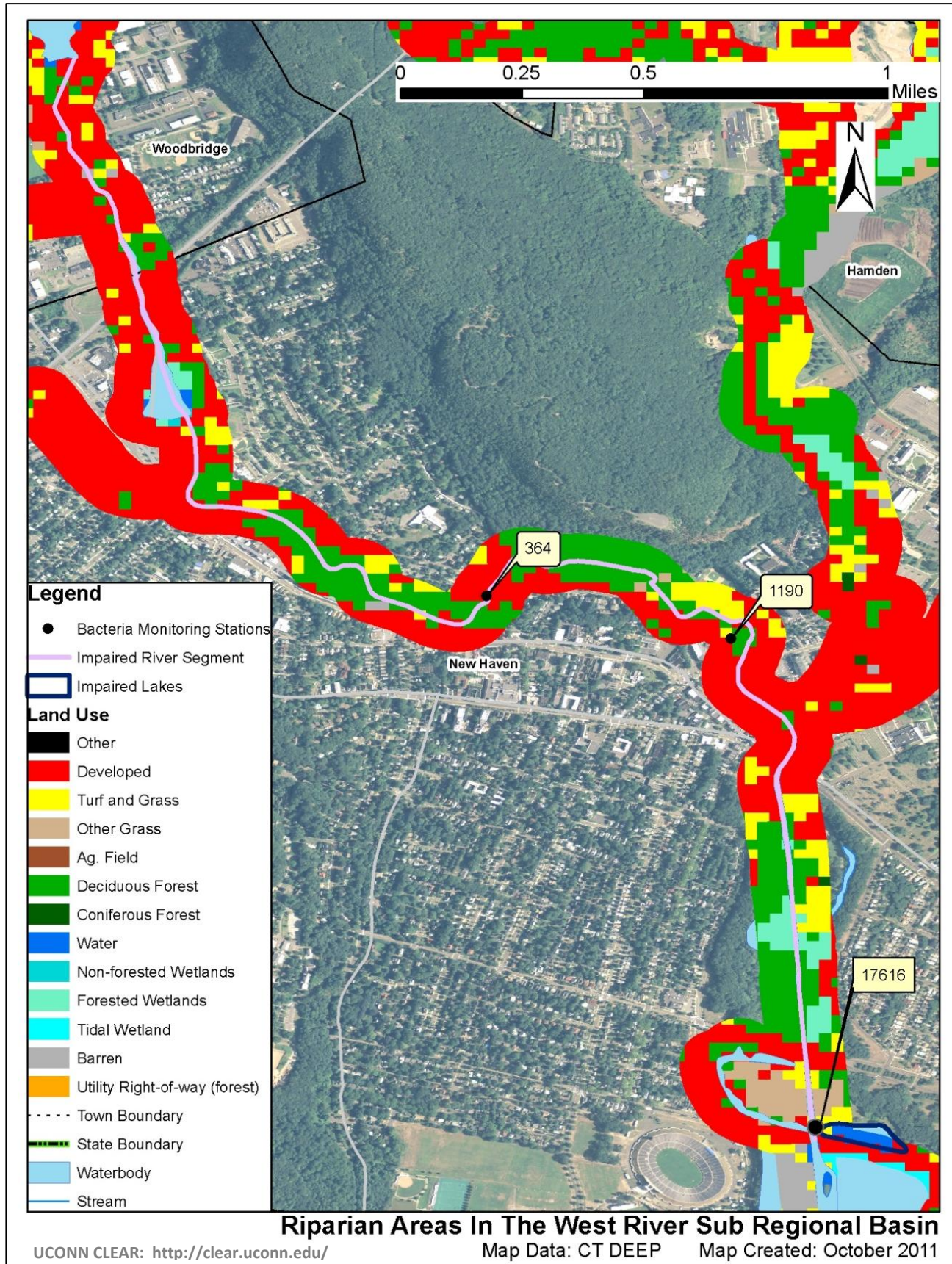
Riparian Buffer Zones

The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their soils, hydrology, and vegetation, natural riparian areas influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms. Any change to the natural riparian buffer zone can reduce the effectiveness of the natural buffer and has the potential to contribute to water quality impairment (USEPA, 2011b).

The CLEAR program at UCONN has created streamside buffer layers for the entire State of Connecticut (<http://clear.uconn.edu/>), which have been used in this TMDL. Analyzing this information can reveal potential sources and implementation opportunities at a localized level. The land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The majority of the riparian zone for the impaired segment of the West River and Edgewood Park Pond is characterized by developed, turf grass, and deciduous forest land uses (Figure 10). As previously mentioned, developed areas are a potential source of bacterial contamination.

Figure 10: Riparian buffer zone information for the West River watershed



CURRENT MANAGEMENT ACTIVITIES

The Town of Woodbridge and the City of New Haven have developed and implemented some programs to protect water quality from bacterial contamination. As indicated previously, the portion of the watershed surrounding the impaired segments is regulated under the MS4 program. The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the State. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures:

1. Public Education and Outreach.
2. Public Involvement/Participation.
3. Illicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management in the new development and redevelopment.
6. Pollution prevention/good housekeeping for municipal operations.

Each municipality is also required to submit an annual update outlining the steps they are taking to meet the six minimum measures. All updates that address bacterial contamination in the watershed are summarized in Tables 8 and 9.

Table 8: Summary of MS4 requirement updates related to the reduction of bacterial contamination from New Haven, CT (Permit #GSM000030)

Minimum Measure	New Haven 2010 Annual Report Update
Public Outreach and Education	1) Produced an all encompassing "green" pamphlet that covers many things the city's residents can take to protect the environment including stormwater related issues.
Public Involvement and Participation	2) Stenciled several catch basins.
Illicit Discharge Detection and Elimination	No updates.
Construction Site Stormwater Runoff Control	No updates.
Post Construction Stormwater management	No updates.
Pollution Prevention and Good Housekeeping	1) Conducted routine street sweeping.
	2) Cleaned 4,500 catch basins.

Table 9: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Woodbridge, CT (Permit # GSM000043)

Minimum Measure	Woodbridge 2010 Annual Report Update
Public Outreach and Education	1) Ran an educational video on stormwater on the local Cable station each year.
Public Involvement and Participation	No updates.
Illicit Discharge Detection and Elimination	No updates.
Construction Site Stormwater Runoff Control	No updates.
Post Construction Stormwater management	No updates.
Pollution Prevention and Good Housekeeping	1) Swept all paved roads and parking lots during March and April.
	2) Cleaned catch basins in May and June. All structures were checked and those that needed service were cleaned. A total of 1,636 structures were maintained.

RECOMMENDED NEXT STEPS

As shown above, the Town of Woodbridge and the City of New Haven have developed and implemented programs to protect water quality from bacterial contamination. Future mitigative activities are necessary to ensure the long-term protection of the West River and Edgewood Park Pond and have been prioritized below.

1) Continue with an implementation plan to remove all CSOs in the West River Watershed.

There are multiple CSOs located on the West River. The Greater New Haven Water Pollution Control Authority (GNHWPCA) is a regional water pollution authority covering the municipalities of New Haven, East Haven, Hamden, and Woodbridge (www.gnhwpc.com). The Authority is in the initial stages of implementing a program aimed at removing of all the CSOs in the area. The stated goal of the project is to improve the water quality of the West River, Mill River, Quinnipiac River, New Haven Harbor, and ultimately Long Island Sound (GNHWPCA, 2011).

Removal of CSOs is cost inhibitive and municipalities may not have the resources to handle such a task on their own. In order to assist with implementing these large scale projects, the State of Connecticut developed the Connecticut Clean Water Fund (CWF). The fund provides financial assistance to municipalities for planning, design, and construction of wastewater collection and treatment projects. The CWF funds 20% of the project cost and provides a low interest loan for the remaining balance. The CWF has a special incentive for entities attempting to correct CSOs. CSO correction projects receive funding for 50% of the project cost and a low interest loan for the remainder (CTDEEP, 2012). This financial support allows projects such as GNHWPCA's CSO removal project to move forward. It is important for the Town of Woodbridge and the City of New Haven to continue working with and supporting the GNHWPCA in its CSO removal efforts. Removing the CSO on the impaired segment of the West River near the northern end of Edgewood Park would help reduce bacteria concentrations within the West River and should continue to be a priority. As long as the CSOs on the West River are active, they will be a potential source of bacterial contamination to the West River.

2) Identify areas along the West River and Edgewood Park Pond to implement Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, the City of New Haven and the Town of Woodbridge are MS4 communities within the West River watershed regulated by the MS4 program. Since 41% of the watershed is considered urban and the entire area surrounding the impaired segment of the West River has an impervious cover greater than 16%, stormwater runoff is likely contributing bacteria to the waterbody. To identify specific areas that are contributing bacteria to the impaired segment of the West River and Edgewood Park Pond, the town should conduct wet-weather sampling at stormwater outfalls that discharge directly to the West River and Edgewood Park Pond. To treat stormwater runoff, the towns should also identify areas along the developed sections of the West River, particularly along the impaired segment and near Edgewood Park Pond, to install BMPs that encourage stormwater to infiltrate into the ground before entering the waterbodies. These BMPs would disconnect impervious areas and reduce pollutant loads to the West River's impaired segment and Edgewood Park Pond. More detailed information and BMP recommendations can be found in the core TMDL document.

3) Evaluate municipal education and outreach programs regarding animal waste.

Edgewood Park Pond is within Edgewood Park in New Haven. Any education and outreach programs within New Haven should highlight the importance of not feeding waterfowl and wildlife, and managing waste from dogs and other pets within Edgewood Park. Municipalities and residents can take measures to minimize waterfowl-related impacts such as allowing tall, coarse vegetation to grow in the riparian areas of the impaired segment of the West River and Edgewood Park Pond that are frequented by waterfowl. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shore will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl, such as ducks, geese, and swans may contribute to water quality impairments in the West River watershed, especially the West River and Edgewood Park Pond, and can harm human health and the environment.

Animal wastes should be disposed of away from any waterbody or storm drain system. BMPs effective at reducing the impact of animal waste on water quality include installing signage, providing pet waste receptacles in high-uses areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.

4) Implement a program to evaluate the sanitary sewer system.

Nearly all residents around the impaired segment of the West River and Edgewood Park Pond relies on a municipal sewer system (Figure 6). Ensuring there are no leaks or overflows from the sanitary sewer in this area should be made a priority. It is important for New Haven to develop a program to evaluate its sanitary sewer and reduce leaks and overflows, especially in the areas around the impaired segment of the West River and Edgewood Park Pond. This program should include periodic inspections of the sewer line.

5) Develop a system to monitor septic systems.

There is a small portion of the watershed near the impaired segment of the West River in Woodbridge where residents rely on septic systems. If not already in place, Woodbridge should establish a program to ensure that existing septic systems are properly operated and maintained. For instance, communities can create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of the sub-standard systems within a reasonable timeframe could also be adopted. Municipalities can also develop programs to assist citizens with the replacement and repair of older and failing systems.

6) Continue monitoring of permitted sources.

Previous sampling of the discharge from the US Postal Service in New Haven has shown elevated levels of fecal coliform bacteria, an indicator of bacterial pollution (Table 7). Further monitoring will provide information essential to better locate, understand, and reduce pollution sources. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility are an additional recommendation. Regular monitoring should be established for all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection.

Section 6(k) of the MS4 General Permit requires a municipality to modify their Stormwater Management Plan to implement the TMDL within four months of TMDL approval by EPA if stormwater within the municipality contributes pollutant(s) in excess of the allocation established by the TMDL. For discharges to impaired waterbodies, the municipality must assess and modify the six minimum measures of its plan, if necessary, to meet TMDL standards. Particular focus should be placed on the following plan components: public education, illicit discharge detection and elimination, stormwater structures cleaning, and the repair, upgrade, or retrofit of storm sewer structures. The goal of these modifications is to establish a program that improves water quality consistent with TMDL requirements. Modifications to the Stormwater Management Plan in response to TMDL development should be submitted to the Stormwater Program of DEEP for review and approval.

Table 10 details the appropriate bacteria criteria for use as waste load allocations established by this TMDL for use as water quality targets by permittees as permits are renewed and updated, within the West River watershed.

For any municipality subject to an MS4 permit and affected by a TMDL, the permit requires a modification of the SMP to include BMPs that address the included impairment. In the case of bacteria related impairments municipal BMPs could include: implementation or improvement to existing nuisance wildlife programs, septic system monitoring programs, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) programs, and increased street sweeping above basic permit requirements. Any non-MS4 municipalities can implement these same types of initiatives in effort to reduce bacteria source loading to impaired waterways.

Any facilities that discharge non-MS4 regulated stormwater should update their Pollution Prevention Plan to reflect BMPs that can reduce bacteria loading to the receiving waterway. These BMPs could include nuisance wildlife control programs and any installations that increase surface infiltration to reduce overall stormwater volumes. Facilities that are regulated under the Commercial Activities Stormwater Permit should report any updates to their SMP in their summary documentation submitted to DEEP.

Table 10. Bacteria (e.coli) TMDLs, WLAs, and LAs for Recreational Use

Class	Bacteria Source	Instantaneous <i>E. coli</i> (#/100mL)						Geometric Mean <i>E. coli</i> (#/100mL)	
		WLA ⁶			LA ⁶			WLA ⁶	LA ⁶
	Recreational Use	1	2	3	1	2	3	All	All
A	Non-Stormwater NPDES	0	0	0				0	
	CSOs	0	0	0				0	
	SSOs	0	0	0				0	
	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235 ⁷	410 ⁷	576 ⁷				126 ⁷	
	Stormwater (non-MS4)				235 ⁷	410 ⁷	576 ⁷		126 ⁷
	Wildlife direct discharge				235 ⁷	410 ⁷	576 ⁷		126 ⁷
	Human or domestic animal direct discharge ⁵				235	410	576		126

(1) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: [Guidelines for Monitoring Bathing Waters and Closure Protocol](#), adopted jointly by the Department of Environmental Protections and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.

- (2) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.
- (3) **All Other Recreational Uses.**
- (4) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of sewage treatment plant effluents is not required consistent with Standard 23. (Class B surface waters located north of Interstate Highway I-95 and downstream of a sewage treatment plant providing seasonal disinfection May 1 through October 1, as authorized by the Commissioner.)
- (5) Human direct discharge = swimmers
- (6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations
- (7) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

7) Ensure there are sufficient buffers on agricultural lands along the upstream portion of West River.

If not already in place, agricultural producers should work with the CT Department of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service to develop conservation plans for their farming activities within the watershed. These plans should focus on ensuring that there are sufficient stream buffers, that fencing exists to restrict livestock and horse access to streams and wetlands, and that animal waste handling, disposal, and other appropriate Best Management Practices (BMPs) are in place. Particular attention should be paid to the agricultural operation located within the riparian buffer zone near the beginning of the impaired segment of the West River.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL**Table 11: West River Bacteria Data****Waterbody ID:** CT5305-00_01**Characteristics:** Freshwater, Class A, Potential Drinking Water Source, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply**Impairment:** Recreation (*E. coli* bacteria)**Water Quality Criteria for *E. coli*:**

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:Geometric Mean: **86%**Single Sample: **88%****Data:** 1998 and 2010 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle**Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on the West River with annual geometric means calculated**

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
1190	500 meters upstream of Blake Street crossing	8/11/2010	2400	dry	597
1190	500 meters upstream of Blake Street crossing	8/26/2010	3300* (88%)	wet	
1190	500 meters upstream of Blake Street crossing	9/9/2010	370	dry	
1190	500 meters upstream of Blake Street crossing	9/14/2010	310	dry	
1190	500 meters upstream of Blake Street crossing	9/20/2010	460	dry	
1190	500 meters upstream of Blake Street crossing	9/22/2010	300	dry	
1190	500 meters upstream of Blake Street crossing	9/27/2010	190	wet	
1190	500 meters upstream of Blake Street crossing	9/29/2010	680	dry	
364	Valley Road crossing	7/7/1998	1350 [†]	dry	869* (86%)
364	Valley Road crossing	9/29/1998	560	dry	

Shaded cells indicate an exceedance of water quality criteria[†]Average of two duplicate samples***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for all monitoring stations on West River

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
1190	500 meters upstream of Blake Street crossing	2010	2	6	597	792	544
364	Valley Road crossing	1998	0	3	869	NA	869
Shaded cells indicate an exceedance of water quality criteria							
Weather condition determined from rain gage at Tweed KMMK station in New Haven, CT							

Table 12: Edgewood Park Pond Bacteria Data**Waterbody ID:** CT5305-00-3-L1_01**Characteristics:** Freshwater, Class A, Potential Drinking Water Source, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply**Impairment:** Recreation (*E. coli* bacteria)**Water Quality Criteria for *E. coli*:**

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:Geometric Mean: **62%**Single Sample: **94%****Data:** 2011 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle**Single sample *E. coli* (colonies/100 mL) data from Station 17616 on Edgewood Park Pond with annual geometric means calculated**

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
17616	Pond outfall	5/11/2011	52	dry	334* (62%)
17616	Pond outfall	5/16/2011	630	dry	
17616	Pond outfall	6/3/2011	63	dry	
17616	Pond outfall	6/7/2011	97	dry	
17616	Pond outfall	6/14/2011	4100* (94%)	wet	
17616	Pond outfall	7/13/2011	160	dry	
17616	Pond outfall	8/10/2011	1400	wet	
17616	Pond outfall	8/16/2011	2600	wet	
17616	Pond outfall	9/21/2011	190	dry	
17616	Pond outfall	9/28/2011	190	unknown	

Shaded cells indicate an exceedance of water quality criteria***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for Station 17616 on Edgewood Park Pond

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
17616	Pond outfall	2011	3	6	356	2462	135
Shaded cells indicate an exceedance of water quality criteria							
Weather condition determined from rain gage at the Hartford Bradley International Airport							

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